ECOSYSTEM BASED MANAGEMENT (EBM) WORKING GROUP
Williams Coast Guard Building

Boston, MA
9:30am to 5:00pm
3 June 2004

MEETING SUMMARY

ACTION: **Changes to the 12 April, 2004 Meeting Summary**
The Working Group (WG) accepted the summary of the meeting held on 12 April, 2004, with the following revisions:

- Page 7, **Action Plan Scenario 3B – Sustainable Extraction: Status Quo Management Option**, ***Answer*** to ***Question 1***, wording was change from "…no action needs to done since it will not happen anyway." to "…no action needs to be done based on existing data."

ACTION: **Steven O'Leary Paper**
Mason Weinrich, the Whale Center of New England, will make the 1995 evaluation paper by Steven O'Leary available to the WG. This paper recommends Stellwagen Bank National Marine Sanctuary (SBNMS) boundary expansion.

ACTION: **Action Plan Assignment**
The Chair tasked the WG with providing the SBNMS staff with the following:
1. Comments on each action plan (what do you like or dislike about the plans)
2. Indicate your preference for a plan.
All comments are to be delivered to Ben Cowie-Haskell, SBNMS staff, no later than 25 June 2004.

ACTION: **Next Meeting**
The next EBM WG meeting will be held on 19 July 2004, at the SBNMS. Should a final date be needed, the WG set 10 August 2004, as the date for the final meeting, to be held at the SBNMS.

Working Group Attendees (June 3, 2004):

Name	**WG Seat / Affiliation**	**Attendance**
John Williamson	SAC Chair	Present
Ben Cowie-Haskell	Team Lead (SBNMS)	Present
David Wiley	Co-Lead (SBNMS)	Not-Present
Peter Auster	UConn, NURC	Present
Les Kaufman	Boston University	Present
Ed Barrett	MA Fisherman's Partnership	Present
Priscilla Brooks	CLF	Present
Susan Farady	The Ocean Conservancy	Not-Present
Jerry Hill	Yankee Fleet	Not-Present
David Pierce	MA DMF	Present
Tony Wilbur	MA CZM	Not-Present
Dave Casoni	Commercial Fishing Industry	Present
Tom DePersia	Big Fish II Sportfishing Charters	Not-Present
Larry Madin	WHOI	Present
Jon Brodziak	NOAA Fisheries	Present
Deirdre Kimball	NOAA Fisheries	Present
Paul Howard	NEFMC	Not-Present
Chris Kellogg	Alternate for Paul Howard	Present
Geoffrey Smith	Alternate for Susan Farady	Present
Jason Burtner	Alternate for Tony Wilbur	Present
Others Present		
Olivia Rugo	MA Fishermen's Partnership	Present
Mary Beth Tooley	ECPA	Present
David Bergeron	MA Fishermen's Partnership	Present
Richard Taylor	Coastal Ocean Observation & Analysis UNH	Present
Mason Weinrich	Whale Center of NE	Present
Ivanna Bandura	CLF	Present
Timothy Feehan	PSGS	Present

WELCOME AND ADOPTION OF AGENDA

John Williamson, WG Chair welcomed the WG and opened the meeting. The agenda for the meeting was presented and approved by the WG. The Chair also asked for corrections to the summaries for the 12 April 2004, meeting of the EBM WG. The WG accepted the summary, pending the corrections offered by WG members. It was also decided that, due to the absence of certain members of the WG, all decisions made during this meeting were subject to review by absent members.

OLD BUSINESS AND ACTION ITEMS

All SBNMS WG Information

Ben Cowie-Haskall's task of assembling summaries of action plans developed by other groups is on-going. However, Geoffrey Smith, the Ocean Conservancy and a member of the Ecosystem Alterations (EA) WG, was able to briefly describe recommendations made by the EA WG. These include:

- Recommendations on Cables and Pipelines in the Sanctuary
- Recommendations on the creation of a Research Group to identify research needs in the Sanctuary
- Recommendations on research set aside areas, however the duration of such set asides has not been determined.
- Recommendations on the removal of biomass from the Sanctuary, which includes a recommendation to prevent the development of a sand lance fishery.

Information from Gloucester Fishermen
David Pierce, MA Department of Marine Fisheries, continues to gather information on fisheries and fishing methods. As an off-shoot of David's on-going work, Ed Barrett, commercial fisherman, and Richard Taylor, Coastal Ocean Observations and Analysis at the University of New Hampshire, have compiled data on fishing gear types in the SBNMS. This information includes data on fishermen from MA including the North Shore, South Shore, and Provincetown. Their findings are presented in the Presentations section of this document.

Action Plan Alternatives
WG members were assigned action plans to develop for this meeting. The three action plans to be developed were:

- Wilderness Action Plan
- Sustainable Use Action Plan
- Middle Path Action Plan

These action plans are presented in the Presentations section of this document.

PRESENTATIONS

Jeffrey's Ledge Boundary Expansion Feasibility Analysis
Mason Weinrich presented information on why expanding the SBNMS boundary to include Jeffrey's Ledge would be beneficial. The research presented is largely based on marine mammals, but the information could be applied to the ecosystem as a whole. Jeffrey's Ledge is an underwater ledge, larger than Stellwagen Bank, extending from just northeast of MA to off southern ME, and is 33 miles long by 2 to 6 miles wide. Typical depths for Jeffrey's ledge range from 160 to 200 ft. The substrate type is a mix of sand, mud, rocks and boulders. Other features of the Jeffrey's Ledge area include Scantum Basin, The Prong, and The Fingers, all of which are important areas for local fishermen and marine life. Currently, the boundary for the SBNMS encompasses the southeastern third of Jeffrey's Ledge.

Herring as Buffer
Herring are abundant on Jeffrey's Ledge, which is an important spawning ground for them. Herring on Jeffrey's Ledge may act as a "buffer" prey for predator species in times of low sand lance abundance. Sand lance are an important prey on Stellwagen Bank. However, their abundance has been shown to be cyclical, working on a 7 to 8 year cycle. Sand lance abundance levels were observed to be low on Stellwagen Bank from 1986 to 1987, and again from 1993 to 1995. This may have been an apparent cause in the shift of humpback whale usage from Stellwagen Bank to Jeffrey's Ledge from 1992 to 1994. Humpback whales may have moved from areas with low abundance of sand lance to areas high in abundance of herring. This data, however, does not show increased usage of Jeffrey's Bank by juvenile

whales which may indicate that it is not ideal habitat for juvenile humpback whales. Whales may not have been the only predator species to shift in this way. Groundfish, tuna, basking sharks, fin whales and seabirds were observed to shift their usage to Jeffrey's Ledge; however, the level of data for humpback whales is high while data for the other species were collected from observations. Based on this data, either herring and Jeffrey's Ledge are a "buffer" prey and ecosystem for Stellwagen Bank marine predators, or they are a key component to the Stellwagen ecosystem.

Spawning Habitat
As stated above, Jeffrey's Ledge serves as an important spawning habitat for herring in the Gulf of Maine (GOM). Based on hydroacoustic surveys in October, 1997, it was estimated that there was 21,000 to 41,000 mt of herring on Jeffrey's Ledge in 200 nm^2. This area most likely serves as a major source of recruitment, and may be the most important spawning ground for herring in the western GOM.

Right Whale Habitat
Right whales are a critically endangered species, numbering only 300 to 350 individuals. These whales summer in the Bay of Fundy and the Scotian shelf, disappear in the fall, then calving females appear off of Florida and Georgia in the winter, while other whales appear in Cape Cod Bay in February and March. In 2001, a report based on data from whale watch boats, Cetacean and Turtle Assessment Program (CETAP), and anecdotal evidence, found mother/calf pairs and sporadic transients of the eastern edge of Jeffrey's Ledge. There were also unusual numbers of right whale sightings on Jeffrey's Ledge in the fall. Aerial and boat-based surveys (2002 and 2003 respectively) found high use of Jeffrey's Ledge, with right whales present from October through mid-December. Right whales were resident in this area for up to 40 days.

Threats to Jeffrey's Ledge
The threats to the SBNMS are shared by Jeffrey's Ledge. Fishing of the herring resource could be a potential threat. Jeffrey's ledge is heavily used by mid-water trawlers. Local displacement of the resource has been documented and could be linked to trawling. After predators have set up on schools of herring, these predators disperse quicker after a trawler passes than if no trawler has passed through. It is also noted that 15 to 20 years ago, predators would stay for months on Jeffrey's Ledge, and now only spend a matter of days. There are also habitat threats to Jeffrey's Ledge including outflows from Maine and New Hampshire, pollutant flow from the Merrimac River, and boat use is similar to that seen in the SBNMS.

Rationale for Boundary Expansion
In 1995, a study looked at 3 options:

- No protection
- Boundary Expansion
- Abutting the SBNMS

It was determined that boundary expansion to include Jeffrey's Ledge should be a recommendation. Expansion would provide consistent management for 2 vital areas in the GOM, as well as consistent management for Jeffrey's Ledge itself which currently has a third of its area within the SBNMS. This would also provide management over an area containing 2 prey bases necessary for marine predators. There is also a need to protect the primary habitat for critically endangered species of importance to the SBNMS like the right whale.

Questions & Answers

Question 1: Why would Jeffrey's Ledge not be an ideal habitat for juvenile humpback whales?

Answer: This idea is still a hypothesis, and not fact. Herring may be larger, quicker and tougher to catch than sand lance. Juvenile humpback whales may not be able to catch herring easily. What is known is that humpback calf survival was very low during the time of the shift.

Question 2: How many different species do humpback whales consume?

Answer: Humpback whales feed on a variety of species. The composition of prey items is close to 95 percent fish and 5 percent plankton. 90 percent of the fish eaten by humpback whales is made up of sand lance and herring.

Question 3: Since Atlantic herring is migratory, do the migratory patterns of herring correspond to the migration of whales?

Answer: The evidence is shown by the shift; however there is no hard data on it.

Question 4: Was there evidence that the humpback whales were nutrient stressed when they shifted their usage to Jeffrey's Ledge?

Answer: It is very difficult to get that data, but there was low calf survival which could be due to low nutrient levels.

Question 5: What is the estimated number or proportion of the right whale population that is using Jeffrey's Ledge?

Answer: It was calculated to be 8 percent. However, this was only after 1 year of survey. The data is not strong, but we are waiting for more data from a pop-up tagging study.

Question 6: Right whales seem to be associated with deep holes and ledges. Is there a correlation?

Answer: Right whales seem to favor habitat that is 60 to 100 fm or deeper. They are deep feeders on a deep resource. Preliminary data indicates that they are associated with basins located near areas with ledges.

Comment: WG members suggested that there may be some interaction with currents and bottom topography, such as what happens in the Bay of Fundy. Currents interacting with bottom topography may be creating patches of prey.

Question 7: If right whales favor deep habitat, then why do they show up in Cape Cod Bay?

Answer: This seems to be an exception to the rule. The whales may simply be following the resource. Currents may bring patches of prey into Cape Cod Bay and the whales follow it in.

Question 8: What is the major prey item for Atlantic herring?

Answer: Herring feed mostly on copepods and plankton.

Question 9: Is the point of expanding the SBNMS boundary to regulate or eliminate herring fishing on Jeffrey's Ledge?

Answer: No. Jeffrey's Ledge is open to the same threats posed to the SBNMS. Expanding the boundary would bring the rest of Jeffrey's Ledge under the mandate of the Sanctuary Act.

Comment: A WG member expressed that Jeffrey's Ledge could be acting like a sill to under water currents that forces nutrients to move over the ledge or down to Stellwagen Bank.

Stellwagen Bank is essentially down stream. This is why the boundary should be expanded to include all of Jeffrey's Ledge.

Comment: There needs to be a specific habitat reason to expand the boundary. Some WG members felt that this was providing the habitat reason needed. To the extent that there are areas in the GOM that are linked, Jeffrey's Ledge and Stellwagen Bank should be considered together.

Comment: WG members expressed that both Jeffrey's Ledger and Stellwagen Bank are part of the GOM ecosystem. Both are important areas with clear links to sand lance, herring, and other species. The linkages with these components provide the rationale to expand the boundary to put all the components under the protection of the Sanctuaries Act.

Question 10: Instead of looking into boundary expansion over the next few years, it seems as though this is a recommendation for boundary expansion now?

Answer: There are 2 options here. First, it can be interpreted as yes, do it now since the data shows the need. Second, it can be interpreted as this is an interesting concept that should be explored in greater detail.

Question 11: The key component here seems to be the management of herring, but the SBNMS is unable to regulate fishing. Should this just be a question for the New England Fishery Management Council (NEFMC) and the Atlantic States Marine Fisheries Commission (ASMFC)?

Answer: The threats to Stellwagen Bank are the same as the threats to Jeffrey's Ledge. It is not just a question about herring. There is an argument here for the Sanctuary to regulate oil exploration, drilling, cables, and pipe lines. This protection should be extended to Jeffrey's Ledge as well.

Atlantic Herring Fishery

Mary Beth Tooley provided information on the status of the Atlantic herring resource and the management of the fishery. Atlantic herring is an abundant species present in the Northwest Atlantic that supports a significant fishery of economic value to coastal communities in New England. The stock biomass is expected to be high in the near future, as recruitment appears to be strong. The stock is not over fished and over fishing is not occurring.

Biomass

The total stock biomass for Atlantic herring has been through large changes from 1960 to 2002. From 1960 to 1970, there was a steady decline from about 1.4 million mt to a low of 87,000 mt in 1982. Much of this decline is attributed to the presence of foreign herring fishing fleets fishing the area during this time period. Since foreign fleets have been prevented from fishing the stock, there has been a steady increase from 1982 to 2000, to above 1.0 million mt in 1994 and above 1.8 million mt in 2000.

Removals

Landings of herring greatly exceeded losses to natural mortality (M) during the International Commission for the Northwest Atlantic Fisheries (ICNAF) fishery in the late 1960s through the mid 1970s. More recently, landings have remained below losses to M and during 1998 to 2002, these losses are lower by a factor of 3 to 3.5. Total removals in the 1970s were much higher than they are currently, due in part to fishing by foreign fleets. Landings peaked in 1968 at 469,535 mt and exceeded 200,000 mt through the mid 1970s. Since 1990, total removals of Atlantic herring from the stock complex have ranged from 77,000 to 150,000 mt (average 107,000 mt).

Management Measures
A fishery management plan (FMP) was developed by the NEFMC and implemented by the National Marine Fishery Service (NMFS) in 2001. The primary management measures were:

- The adoption of a Total Allowable Catch (TAC) for the herring fishery and distribution of the TAC across time and area.
- Closure of the directed herring fishery in an area when the TAC is reached.
- The permitting of all participating vessels, operators, dealers, and processors.
- Mandatory data reporting for all licensed vessels, dealers, and processors.
- Restrictions on size of vessels allowed in the fishery.
- Restrictions on joint venture processing activities.
- Adoption of an overfishing definition.
- Designation of essential fish habitat.

In addition, Amendment 1 to the ASMFC Interstate FMP for Atlantic Herring was approved and adopted by the Commission in 1998. Amendment 1 contained many of the same provisions as the Council's Herring FMP in addition to addressing such issues as spawning closures and a mechanism for implementing effort controls (days out of the fishery). Theses included:

- TAC: Stellwagon is included in the Area 1A annual specification, currently 60,000 mt, seasonally divided: Jan/Jun – 6,000 mt, and Jun/Dec – 54,000 mt. The fishery is closed when 95% of the TAC is taken.
- Effort controls: The states FMP prohibits landing of herring two, mandatory days of the week. Additionally, the industry, through a gentlemen's agreement takes a 48 hour "no nets in the water" measure to complement the states plan to protect the resource and extend the fishing year.
- Spawning Closures: The states FMP implements rolling closures in the inshore GOM through the prohibition of landings. Closures, that are based on on-going sampling, last for at least a 4 week period that can be extended. The default closure for NH/MA is 21 September.

The NEFMC and the ASMFC are both in the process of making Amendments to their plans. Measures under consideration include:

- Reference Points
- Limited Access
- Boundary Modifications
- Gear Restricted areas
- Definition of a Midwater Trawl
- Bycatch Monitoring
- Exploration of the role of herring as forage

Questions & Answers
Question 1: How well did management track mortality during the high and low periods of abundance?

Answer: Management wanted the Fmax values, but foreign vessels were doing the fishing. We had no controls other than ICNAF.

Question 2: Are there different stocks within the coastal stock complex for herring?

Answer: Yes. There is the GOM spawning stock and the Georges Bank spawning stock. Both stocks over-winter south of Cape Cod and the complex is managed as one stock unit.

Question 3: Are herring and sand lance stocks reciprocal in terms of abundance?

Answer: Looking at the data, it seems that when there is an apparent decrease in sand lance, there is an increase in pelagic species. This is not known for sure.

Question 4: What is the appropriate biomass level for sand lance? Did the sand lance only go as high as it did because herring was over fished?

Answer: This is not clear. It appears that this is the case, but we do not know for sure.

Question 5: Why is the management of Atlantic herring so seasonal?

Answer: It is mainly market driven. August to October is the largest market. The point is to prolong the fishery to continue to have product.

Question 6: In terms of management, are each of the area TACs met?

Answer: Area 1A is hit every year, but the average for the other areas is only 50 percent of the TAC.

Comment: WG members felt that the Atlantic herring fishery is a good example of a well managed fishery, as it is one of the best managed fisheries. They use conservative assumptions, which are making this a well managed fishery.

Question 7: How important is the area just north of Stellwagen Bank?

Answer: It is very important to both fish and fishermen. However, it is not the only area for herring to spawn in the GOM. Fishermen support spawning area closures. The herring fishery is a very cooperative process.

Question 8: Is the spawning stock of herring at Jeffrey's Ledge a distinct component genetically?

Answer: There is no real evidence of that. The fish arrive in waves to spawn so there is a high level of mixing.

Question 9: How many boats are involved in this fishery?

Answer: In 2002, the number of boats was 32.

Comment: WG members stated that from a fishing management perspective, there is not a lot of herring being removed. For Stellwagen Bank, the patches of prey, and their availability, may have an affect on the species that forage on them. We do not have information on the number of patches and the number of fish within the SBNMS. We need to know if there is spot depletion occurring that causes the displacement of the species that forage on herring within the Sanctuary.

Question 10: For the future, do you expect fishing pressure to increase?

Answer: Actually no. I would be expecting a decrease in fishing pressure.

Comment: Some WG members were concerned that the estimates for herring biomass was not good enough, considering Canada has one estimation method and the US has another. There needs to be more research done on the dynamics of the stock.

Comment: Other WG members stated that the absolute number for herring biomass may not be known, but the relative abundance and stability or the stock has been determined. Under current measures, there is no reason the stock will not stay stable. Canada has a retrospective bias in the way it estimates the stock that is not appropriate. The US uses a projection to estimate

recruitment, which is simpler and fits better with survey data. New studies would be beneficial, but current methods and hydroacoustic surveys have been well done.

Question 11: Is there a history of ecological set asides for a forage base?

Answer: Squid has one although I am not sure for herring. There is 300,000 mt set aside to account for predation.

Question 12: On Stellwagen Bank and Jeffrey's Ledge herring fishing, do we have a breakdown as far as seine versus trawl fishing?

Answer: There is no seine fishing, only trawl fishing. Switching the gear on and off the boat becomes an issue, so the boats are staying with trawl gear.

Question 13: Are the spawning closures just in state waters on Jeffrey's Ledge?

Answer: No, they are outside state waters as well.

Action Plan 1 – Wilderness

The members assigned to draft the Wilderness Action Plan were Les Kaufman, Boston University, John Williamson, and Deirdre Kimball, National Oceanic and Atmospheric Administration (NOAA) Fisheries. This group decided it was appropriate to develop two possible scenarios:

1. Absolute Wilderness Scenario: All disruptive activities would cease, making the SBNMS a totally protected, non-extractive reserve. The Sanctuary borders would be expanded to include Jeffrey's Ledge.
2. "Urban Wilderness" Scenario: Includes humans as part of the ecosystem since the Sanctuary is in close proximity to the heavily settled watersheds and heavily impacted waters of the GOM. Zoning and impact restrictions would be employed to promote wilderness attributes to the Sanctuary.

An absolute wilderness encompassing Stellwagen Bank and Jeffrey's Ledge would yield two important benefits. First, areas rich in both herring (to the north) and sand lance (mostly Stellwagen Bank) would be protected, thus providing insurance against low-abundance years for any one of these primary forage species. Second, a crucial feeding area for the north Atlantic right whale would be protected. In addition, the core protected area encompassing the two banks should be surrounded by an easement of additional grounds in which activities that severely disrupt habitat and the distribution and abundance of wildlife are curtailed.

It is virtually impossible to manage the SBNMS as a true wilderness, because many of the organisms that move through the sanctuary are severely impacted outside of its borders. In addition, SBNMS waters are under burgeoning pressure as the regional human population increases in numbers and wealth, thus elevating the demand for use of coastal waters for commercial and recreational fishing, boating, and wildlife watching. In other words, humans are part of the ecosystem. In recognition of these considerations, an alternative paradigm is put forward of an "urban wilderness", in which the goal is the defense and restoration of such wilderness values as can be achieved in the context of proximity to the heavily settled watersheds and heavily impacted waters of the Gulf of Maine. The urban wilderness scenario employs zoning and impact restrictions to preserve a substantial portion of the ecological services that wilderness would provide. The Wilderness Action Plan presented to the WG is shown in Appendix A.

Questions & Answers

Question 1: Is the expression "Urban Wilderness" a new one?

Answer: This expression is not officially known, but it is used to describe city parks.

Question 2: So is an "urban wilderness" one that is inside or next to an urban area?

Answer: It would be a wilderness where people are an integral part, but attributes of a wilderness system are maintained.

Question 3: To have a wilderness, is the point for having areas left untouched addressed?

Answer: Yes it is addressed.

Comment: WG members were concerned that some wording would have to be changed to further address the idea of a wilderness. The language seems to be like fisheries management. It was felt that the only man-made impact that is not controlled is fishing. The wilderness idea was presented to address a scoping comment.

Comment: Other WG members stated that a research area that affects fishing certainly affects it, but it is not fisheries management.

Comment: Other WG members expressed that something that prevents fishing from happening in a particular area is a fishing management issue.

Question 4: What exactly is transit value?

Answer: This is getting in and out of Boston Harbor by crossing the SBNMS. Basically it is shipping lanes.

Question 5: Are the points brought up truly non-negotiable?

Answer: This action plan uses the precautionary approach. We are not sure that data exist that states limits can be sustained given how far we have already pushed them.

Comment: If the points were negotiable and did not hold, some WG members felt that would shift this action plan towards the middle path. It was expressed that having a wilderness would require less monitoring. The middle path would be more information needy.

Action Plan Scenario 2 – Sustainable Use

The members assigned to the third scenario were Ed Barrett, Jon Brodziak, NOAA Fisheries, and David Casoni. Ben noted that Tom DePersia did not meet with the group and did not read the document so he should not be listed as an author since he didn't agree to the document. Jon Brodziak reviewed the Sustainable Use Action Plan, which describes managing the Sanctuary using the sustainable extraction of resources by recognizing: (1) the Sanctuary's uniqueness is substantially due to its importance as a coastal fishing ground; (2) Sanctuary bottom and water column habitats are impacted to varying degrees by human activities such as waste disposal, commercial fishing, shipping, cruise ships and cable-laying in the southwestern GOM, especially in the Sanctuary itself; (3) fisheries management, conservation and habitat protection in the GOM, including the Sanctuary, are the responsibility of the NEFMC, acting under the authority of the Sustainable Fisheries Act, and coastal states; and (4) the Sanctuary is not a closed system but is part of the dynamic Gulf of Maine ecosystem.

The goal of the Sustainable Use Action Plan is to:

1. Continue region-wide support for management, collaborative research, acquisition of fisheries-dependent information, and exploitation policies and initiatives leading to:
    a. an understanding of and improved protection to the Sanctuary's ecological integrity;
    b. knowledge about the extent to which natural and human factors inside and outside the Sanctuary affect that integrity;
    c. an improved understanding of socioeconomic impacts of measures required to protect that integrity.
2. Maintain existing Sanctuary fishing activities consistent with NEFMC management plans and their requirements for sustainable fisheries, habitat protection and bycatch reduction.
3. Strive for biological successes (e.g., increased fish abundance and diversity as well as improved habitat) while avoiding social failures (e.g., alienation of users, disruption of the historic fabric of fishing communities, loss of or inadequate sharing of socioeconomic benefits and inadequate conflict resolution).

The Sustainable Use Action Plan presented to the WG is shown in Appendix B.

Questions & Answers

Question 1: Concerning the temperature anomalies, is there a temperature threshold that affects resident species?

Answer: For fishermen, these anomalies drive how business gets done. Different species are present or absent depending on temperature changes.

Question 2: With monitoring abundances, what species make up the other fin fish?

Answer: Those are species like long-horned sculpin, monkfish, ocean pout, etc. They include the non-exploited fish.

Question 3: Sustainable use deals with extraction. How does that change with eco-tourism, recreational fishing, and other activities that do not deal with extraction?

Answer: All management is really very experimental since new regulations are coming on line. If fishing is a major impact on the Sanctuary, let the experiment of present management go and see if it works.

Comment: WG members felt that there was a need to create balance and allow access. Such an approach would work to the benefit of everyone if all stocks are maintained at sustainable levels.

Comment: WG members expressed that the council should be enough to meet the Sanctuary's mandate.

Comment: Other members stated that there is significantly less fishing effort in the Sanctuary, which is a benefit to biodiversity and helps the Sanctuary. The Sanctuary mandates the protection of the fishing grounds as well.

Question 4: Does this action plan deal with research areas?

Answer: Not really. It identifies the "sliver." The take home message of this action plan is that there is a need to better understand the current use and management of the Sanctuary.

Comment: Some WG members felt that this strategy should include the development of population models for non-exploited species and try to understand the long-term survivorship of

exploited species. The understanding of juvenile cod use within the Sanctuary should be included as well.

Question 5: Is it a major concern that the resolution of current sampling and monitoring is inadequate?

Answer: It is a concern. It is possible to start commercial surveys using commercial boats as platforms for further research.

Action Plan Scenario 3 – Middle Path

The members assigned to Middle Path Action Plan were David Pierce, Susan Farady, the Ocean Conservancy, Ben Cowie-Haskell, and Priscilla Brooks, Conservation Law Foundation. David Pierce reviewed the action plan, which is based on balancing protection and extraction by managing the Sanctuary with the following objectives:

- Understand ecosystem structure and function
- Recognize interconnectedness with larger ecosystem
- Recognize our uncertainty of how systems function
- Manage adaptively
- Maintain public accessibility to SBNMS
- Achieve environmental sustainability of sanctuary resources
- Maintain and enhance biological diversity and ecological integrity
- Reduce habitat impacts by users
- Establish a process for creating a zoning scheme

Though a zoning scheme is mentioned in this Action Plan, the drafting members felt that their small group was not equipped with the information needed to create the zoning scheme. Other experts would be needed to create zones, which at this point was not feasible. The scenario presented to the WG is shown in Appendix C.

Questions & Answers

Question 1: As to the requirement for using the vessel monitoring systems (VMS), was there any thought in making that voluntary?

Answer: No. It was not considered since the idea is to account for commercial use of the Sanctuary.

Comment: It was expressed by some WG members that the objective was to increase the feeling of stewardship with fishermen. If the VMS idea is written to express this idea, making VMS use voluntary could be an option.

Comment: Other WG members stated that other methods could be employed such as the us of log books, or if a vessel is fishing in the Sanctuary it could get a special designation for that after calling in for Days at Sea.

Question 2: For recommendation 4 and 5, while do you feel it will not work?

Answer: You would not get the results on how herring is impacting sanctuary resources.

Comment: WG members felt that not getting measurable results was not quite right. An influx of herring should have a great effect on the behavior of predators. This could be a research idea, a potentially difficult project, but it could be done.

Question 3: What sort of havoc would be caused to the herring fleet if there was a 1 year on and 1 year off for fishing for herring in the Sanctuary?

> ***Answer:*** That would be economically unacceptable. If all the herring move into the sanctuary on a year that was no fishing, the fleet would not be able to operate.

Fishing Usage Chart of SBNMS

Ed Barrett and Richard Taylor presented information they have assembled on fishing gear used and areas fished within the SBNMS by local area fishermen. The data was plotted using geographic information systems (GIS), and was intended to give the general area where fishermen fished with certain gear types. All of the SBNMS is used by one gear type or another. Each gear type was segregated from the rest, mainly because of bottom type. Hard, rocky areas contained gear such as lobster gear and gillnets. Smoother substrates like sand an mud were fished by trawl gear.

Questions & Answers

Question 1: What is the percentage of fishermen that are resident on Stellwagen Bank?

> ***Answer:*** Due to closures and regulations it is 90 percent. The offshore boats do not go in.

Question 2: Why not define the SBNMS fishing community and only let them fish there?

> ***Answer:*** That would be illegal.
>
> ***Comment:*** WG members stated that some local communities feel that they have sacrificed greatly and should be the ones to reap the benefits.

Question 3: Is every part of SBNMS fished by some sort of fishing gear?

> ***Answer:*** This is a general idea of where fishermen fish. The "sliver" is not filled in on the chart. Also, the general areas identified contain wrecks and hard rubble areas that are not fished but are not shown.

Question 4: Is there a possibility for realignment for areas that are currently closed?

> ***Answer:*** Yes that is a possibility through a process that goes through the sanctuary and the NEFMC.

ACTION PLAN DEVELOPMENT

Discussion of Proposed Action Plans

The Chair encouraged open a brief discussion over the development of the three draft Action Plans from the information presented above. Issues raised during this discussion are noted below.

Issue 1: Number of Action Plans

Concern was raised over how quickly the WG was working. Members felt that more time was needed to talk about each of the 3 proposed action plans, before trying to come to consensus on the Middle Path Action Plan.

> ***Discussion:*** WG members felt that the group had not discussed each of the 3 proposed action plans. The action plans, as presented, were still in a straw-man format that needed to be filled in with greater detail. A consensus recommendation would be good enough for the SAC, but having a range of alternatives was also an option. If consensus could be reached, it would be good to recommend the preferred alternative and give reasons why the others were rejected by the WG. It

was determined that WG members could comment on which alternative was more acceptable. The majority opinion was that the Middle Path scenario was preffered, but a few WG members still preferred the Sustainable Use scenario. It was also apparent that many WG members may have preferred the Middle Path scenario, but would like to see parts from the other proposed action plans included.

NEW BUSINESS

Action Plan Assignment

The WG decided that further comments were needed on each of the proposed action plans. Because of this, the Chair tasked the WG with providing the SBNMS staff with comments on which action plan each member preferred, as well as comment on what each member liked and disliked about each of the other action plans. These comments were to focus on the elements that members liked or disliked about each action plan. All comments are to be deliverd to Ben Cowie-Haskell no later than 25 June, 2004.

Next Meeting

The WG was polled for possible dates for the next meeting. The next EBM WG meeting will be held on 19 July, 2004 at the SBNMS. Should a final date be needed, the WG set 10 August, 2004 as the date for the final meeting, to be held at the SBNMS.

FINAL COMMENTS

Meeting adjourned at 5:00 pm.

***Gerry E. Studds* Stellwagen Bank National Marine Sanctuary**
Management Plan Review
Ecosystem-based Management Working Group – Draft Agenda

Date: 3 June 2004
Location: Williams Coast Guard Building
2nd Floor Conference Room
408 Atlantic Ave.
Boston, MA
781-424-0699

TIME	TOPICS AND OBJECTIVES
9:00-9:45	•**Welcome** (coffee and pastries provided) •**Progress update** • Review and approval of meeting summary **Discussion Leader**: John Williamson
9:45-10:15	**Presentation: Jeffrey's Ledge Boundary Expansion Feasibility Analysis** Mason Weinrich, Whale Center of New England
10:15-10:45	• **Presentation: Wilderness Action Plan** Les Kaufman, Larry Madin, John Williamson, and Deirdre Kimball **Objective**: Understand goal and details of action plan
10:45-11:15	• **Presentation: Sustainable Use Action Plan** Jon Brodziak, Ed Barrett, Dave Casoni, and Tom DePersia **Objective**: Understand goal and details of action plan
11:15-12:00	• **Presentation: Middle Path Action Plan** David Pierce, Susan Farady, Ben Cowie-Haskell, and Priscilla Brooks **Objective**: Understand goal and details of action plan
12:00-12:30	**Lunch (**provided**)**
12:30-4:30	**Roundtable discussion: Developing a Middle Path Action Plan** **Discussion Leader**: John Williamson
4:30-5:00	**Reiterate agreements and next steps** **Discussion Leader**: John Williamson

APPENDIX A

Stellwagen wilderness group meeting May 19, 2004:
Plan to enhance/restore wilderness functions and values

This group chose to describe two alternatives. The first is the idea of Absolute Wilderness, which defines core wilderness values with which the second alternative, Urban Wilderness, can be compared. The group recognizes that Urban Wilderness is the more likely outcome.

Absolute Wilderness Scenario

In order to manage the Stellwagen Bank National Marine Sanctuary in a true wilderness state, all disruptive activities must cease. The SBNMS would become a totally protected, non-extractive reserve. In addition, the borders of the Sanctuary would have to be extended so as to encompass Jeffreys Ledge and adjacent areas of high topographic relief, such as "the Fingers." This would yield two important benefits. First, areas rich in both herring (to the north) and sand lance (mostly Stellwagen Bank) would be protected, thus providing insurance against low-abundance years for any one of these primary forage species. Second, a crucial feeding area for the north Atlantic right whale would be protected. In addition, the core protected area encompassing the two banks should be surrounded by an easement of additional grounds in which activities that severely disrupt habitat and the distribution and abundance of wildlife are curtailed.

Urban Wilderness Scenario

It is virtually impossible to manage the SBNMS as a true wilderness, because many of the organisms that move through the sanctuary are severely impacted outside of its borders. In addition, SBNMS waters are under burgeoning pressure as the regional human population increases in numbers and wealth, thus elevating the demand for use of coastal waters for commercial and recreational fishing, boating, and wildlife watching. In other words, humans are part of the ecosystem. In recognition of these considerations, an alternative paradigm is put forward of an "urban wilderness", in which the goal is the defense and restoration of such wilderness values as can be achieved in the context of proximity to the heavily settled watersheds and heavily impacted waters of the Gulf of Maine. The urban wilderness scenario employs zoning and impact restrictions to preserve a substantial portion of the ecological services that wilderness would provide.

The primary mechanism for achieving and maintaining wilderness values is the close monitoring of the ecosystem to allow for more informed and confident decisions in response to changes in human impacts and system state. The core of the program is a well-designed network of research areas and monitoring activities. These provide the data-stream required to manage human activities within the Sanctuary in an adaptive manner, and to thus maintain the viability of human activity in a self-supporting system. The difference between the "urban wilderness" and "compromise" scenarios is the explicit goal of promoting wilderness attributes within the Sanctuary; however, the "compromise" scenario should incorporate "urban wilderness" objectives while allowing extractive use through careful zoning. The urban wilderness scenario differs from "sustainable use" in system attributes such as the size-frequency distribution of organisms, the ecological resiliency of the Sanctuary, and the emphasis on maximizing standing biomass and species diversity rather than gross rates of biomass production.

The return of natural ecological processes to a Sanctuary that is nonetheless subject to some level of extraction and modification, can be effected by safeguarding certain key attributes of the system. In other words, these are non-negotiable requirements of an urban wilderness approach.

For the SBNMS, these elements would include the following:

1) Close fisheries on pelagic forage species: Atlantic and river herrings, and the two species of sand lance.

2) Change boundaries to encompass local ecosystem dynamics. Specifically, expand the sanctuary borders to the north to include extensive areas of bottom that support the herring (to the north) and the sand lances (to the south).

3) Zone refugia for large brood fish as off-limits to all extraction (could allow catch-and-release fishing however).

4) Conduct research to determine necessary areal zones to protect, and to monitor the efficacy of these closures.

5) Fishing would be allowed but on the basis of ecosystem parameters, not just the usual demographic criteria (i.e., not MSY).

6) Fishing must be restricted to low-impact technologies, within delimited zones, the goal being sustainability *within* the Sanctuary. Encourage public sector access to facilitate a general shift from industrial to artisanal/small scale/recreational fisheries. This allows the greatest benefit for the greatest number of people, and is sustainable over time.

7) Restructure shipping lanes to reduce wildlife and endangered species impacts; pursue through direct benefits to Homeland Security.

8) Speed limit on vessels through the Sanctuary, below 13 knots (the mortality threshold for ship-whale collisions).

9) FULLY ENFORCE the Clean Air and Clean Water acts to reduce watershed inputs to the Sanctuary.Watershed management to minimize turbidity and diminish coastal runoff, including, but not limited to , nutrient plumes from rivers. Such management strategies may include, for example, requiring forested easements along all watersheds.

10) Zero ballast water exchange in the Sanctuary to reduce invasive species.

11) EVERY effort must be made to minimize harmful interactions with all marine mammals including NA right whales, and to minimize degradation of the trophic system that supports them (i.e., copepods and forage fish).

12) Some areas must be well selected for full protection to protect biodiversity, and provide untouched reference areas for adaptive management.

13) Any use or crossing of the Sanctuary for cables, pipelines, or conduits must be subject to review and assessed for costs to cover continuing impact monitoring for the lifetime of the easement.

Costs and Benefits of Absolute vs. Urban Wilderness Scenarios

Absolute Wilderness:

BENEFITS

Whalewatching, wildlife watching, tourism (including SCUBA)
existence value
transit value

reduced uncertainty through provision of reference habitats for scientific research necessary for resource management in rest of GOM

spillover and stock enhancement value of protected brood stock and individuals

COSTS

No fishing
Zero ballast water exchange
Requires the elimination or destruction of all artifacts, such as shipwrecks and archaeological sites)

Urban Wilderness:

BENEFITS

Same as for absolute wilderness, except add back limited fishing

Encourage the growth of small-scale, low-impact fisheries consistent with growth of population in the urban centers and demand for recreation.

COSTS

Encourage the growth of small-scale, low-impact fisheries consistent with growth of population in the urban centers and demand for recreation. This is a cost relative to an Absolute Wilderness model, but a benefit from the Urban Wilderness perspective of the public commons, artisinal industries, including fisheries, etc.

Loss of some existence value.

Loss of much of the reference value of absolute wilderness (the establishment of a baseline against which the effects of human activities can be measured). This can be addressed by reserving a portion of the SBNMS as a core region of absolute wilderness.

The report of the US Commission on Ocean Policy "highlights the fact that fishing is a privilege, not a right". It reflects the notion that "the dedicated privilege being granted is access to the fish, rather than the fish themselves." In the "urban wilderness" scenario, this privilege is granted, but in balance to other privileges that people seek from Sanctuary waters, including the privilege of viewing a wild ocean and the wildlife that it would contain but for its removal by people with contrary values.

APPENDIX B

SUSTAINABLE USE ACTION PLAN (BARRETT, BRODZIAK, CASONI)

Overview

The sustainable use action plan is designed to protect sanctuary resources through existing best management practices. This plan focuses on sustainable use with an emphasis on maintaining the national benefits that are produced in the waters of Stellwagen Bank NMS.

Stellwagen Bank is part of the Gulf of Maine ecosystem. Oceanographic conditions in the Gulf of Maine region are influenced by inputs of cold, low-salinity Scotian Shelf water and warm high-salinity slope water (Fig 1). The relative strength of these two primary inputs is dynamic and is influenced by low-frequency changes in the North Atlantic Oscillation (Fig. 2). Changing environmental conditions alter abiotic and biotic processes and make it challenging to discern between human and environmental impacts on the ecological integrity of Sanctuary resources. Complex interrelationships among abiotic and biotic processes along with changing environmental conditions also make it difficult to precisely define what the term "ecological integrity" means (Fig 3). For this reason, a primary focus of the sustainable use plan is to improve monitoring of both biological and environmental parameters within the Sanctuary.

Figure 1. Shallow (<75 m) and deep (>150 m) currents in the Gulf of Maine (Figure courtesy of Dr. David Mountain, Northeast Fisheries Science Center [NEFSC]).

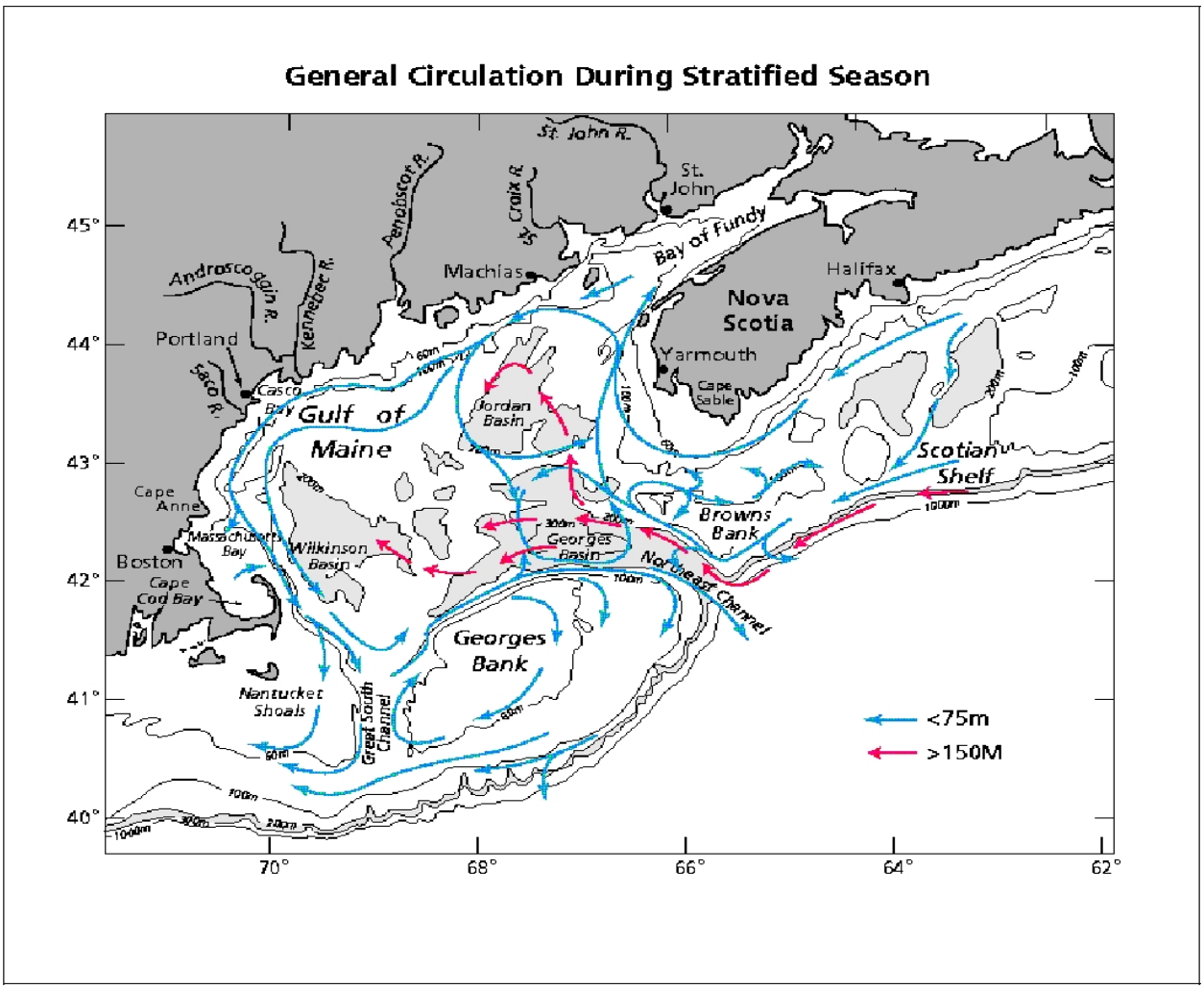


Figure 2. Low-frequency changes in the NAO.

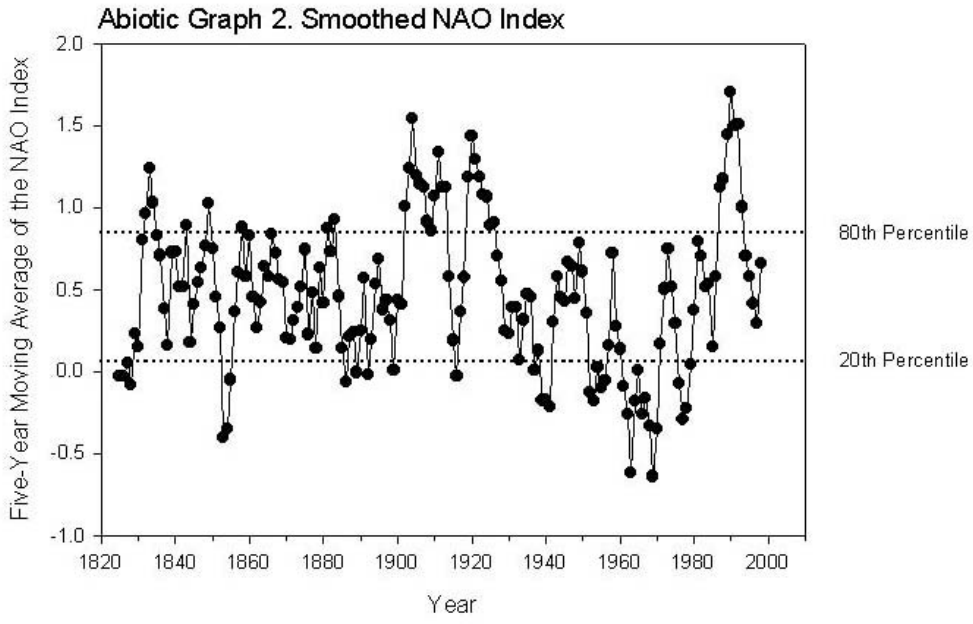
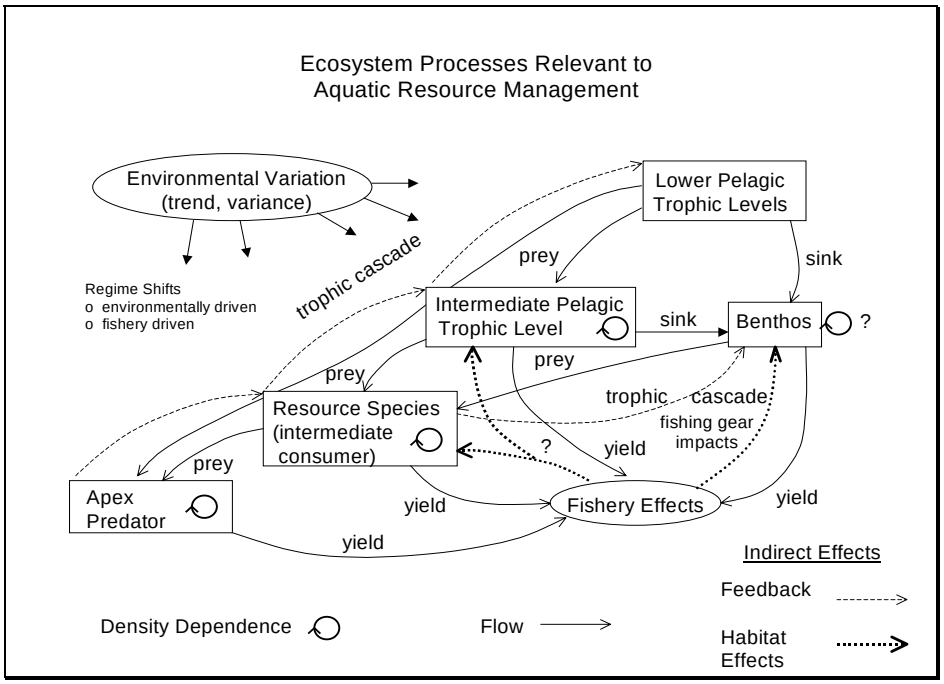


Figure 3. Complex interrelationships between abiotic and biotic processes in aquatic ecosystems (Figure courtesy of Dr. Steve Murawski, NEFSC).



In order to strengthen monitoring of biological and physical oceanographic factors, collaborative scientific partnerships with local user and industry groups should be cultivated. For example, the Fishermen's Initiative for Scientific Habitat and Ecosystem Research (FISHER Initiative) is working to establish a foundation for an ecological understanding of the marine environment in and around Stellwagen Bank and the Massachusetts Bay area. The ultimate goal of this endeavor is to coalesce fishermen's and scientist's empirical and technical knowledge into a legitimate, credible, and durable scientific foundation that promotes an ecosystem-based approach to fisheries management. Initiative partners currently include the Stellwagen Bank National Marine Sanctuary, Harvard University, University of New Hampshire, Massachusetts Institute of Technology's Sea Grant College Program, Boston University's Marine Program, Tufts University, the Massachusetts Division of Marine Fisheries, the Center for Coastal Studies, and numerous commercial fishermen. Fostering such collaborative partnerships will directly improve the quality of information needed for ecosystem-based management.

On May 1st 2004 Amendment 13 to the Northeast Multispecies Fishery Management Plan (http://www.nefsc.noaa.gov/groundfish/) went into effect. This comprehensive plan includes provisions to rebuild depleted groundfish fishery resources and to protect essential fish habitat (Fig. 10 from Amendment 13). Provisions of the plan include reductions in fishing vessel allocations of days-at-sea, establishment of permanent essential fish habitat closed areas, continuation of existing rolling closures, and reductions in bycatch due to improved gear selectivity. Amendment 13 will directly increase the protection of the ecological integrity of Sanctuary resources by substantially reducing fishery-related effects (Fig. 3). In particular, the New England Fishery Management Council's (NEFMC) omnibus essential fish habitat management plan is expected to help to preserve biodiversity and to ensure the long-term sustainability of Sanctuary resources.

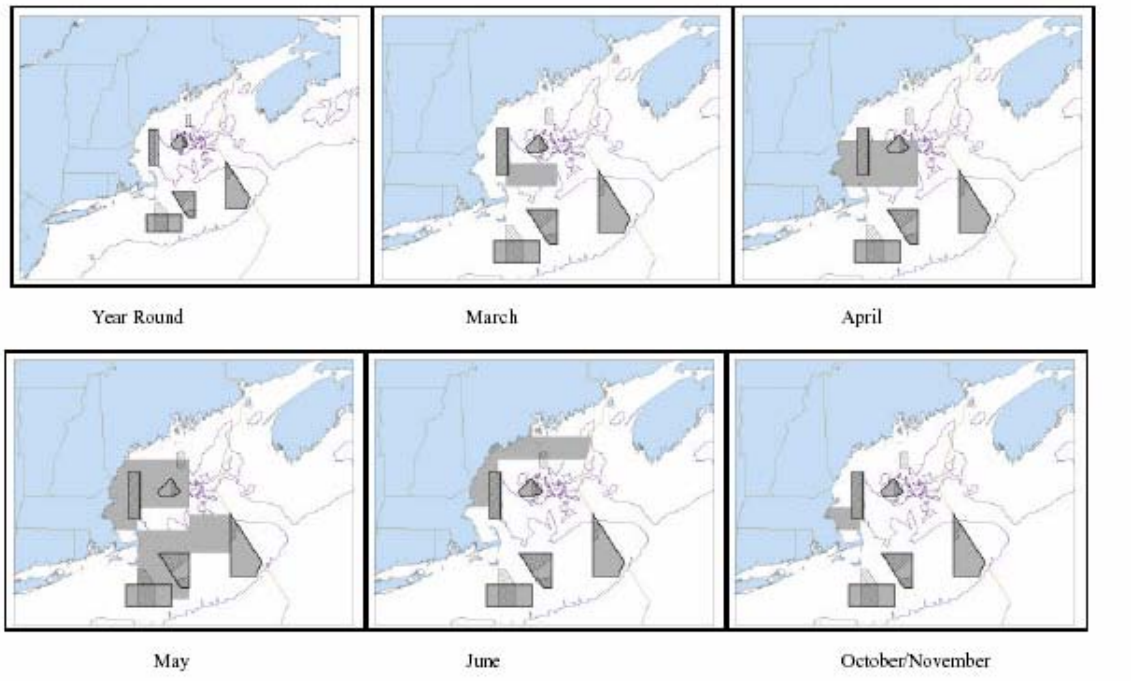


Figure 10 – Proposed action year round and seasonal closed areas. Level 3 habitat areas are cross hatched.

Goal Statement

Barrett, Casoni, DePersia and Pierce reached consensus on the following overall goal. The overall goal was then translated into a set of distinct operational objectives along with potential management actions and performance metrics.

Recognizing (i) the Sanctuary's uniqueness is substantially due to its importance as a coastal fishing ground; (ii) Sanctuary bottom and water column habitats are impacted to varying degrees by human activities such as waste disposal, commercial fishing, shipping, cruise ships and cable laying in the southwestern Gulf of Maine; (iii) fisheries management, conservation and habitat protection in the Gulf of Maine , including the Sanctuary, are the responsibility of the New England Fisheries Management Council (NEMFC), acting under the authority of the Sustainable Fisheries Act, and coastal states; and (iv) the Sanctuary is not a closed system but is part of the dynamic Gulf of Maine ecosystem, the goal of the Sustainable Use Action Plan is to:

1. Continue region-wide support for management, collaborative research, acquisition of fisheries-dependent information, and exploitation policies and initiatives leading to:
    a. an understanding of and improved protection to the Sanctuary's ecological integrity;
    b. knowledge about the extent to which natural and human factors inside and outside the Sanctuary affect that integrity;
    c. an improved understanding of socioeconomic impacts of measures required to protect that integrity.

2. Maintain existing Sanctuary fishing activities consistent with NEFMC management plans and their requirements for sustainable fisheries, habitat protection and bycatch reduction.

3. Strive for biological successes (e.g., increased fish abundance and diversity as well as improved habitat) while avoiding social failures (e.g., alienation of users, disruption of the historic fabric of fishing communities, loss of or inadequate sharing of socioeconomic benefits and inadequate conflict resolution).

Operational Objectives

- **Protect ecological integrity**
  - Management action: Maintain optimum fishery yields at target fishing mortality rate through use of closed areas, trip limits, days-at-sea restrictions, and other measures.
  - Performance metrics: Monitor yield (target yield = 16,100 mt) and fishing mortality (target F=0.23) on Gulf of Maine cod and other stocks.

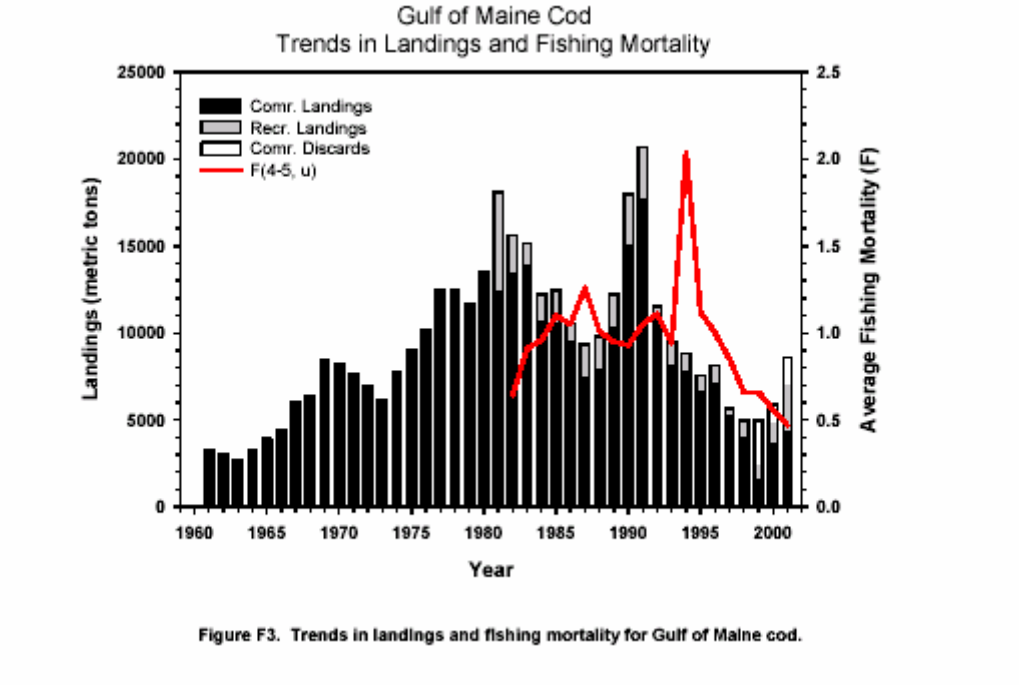
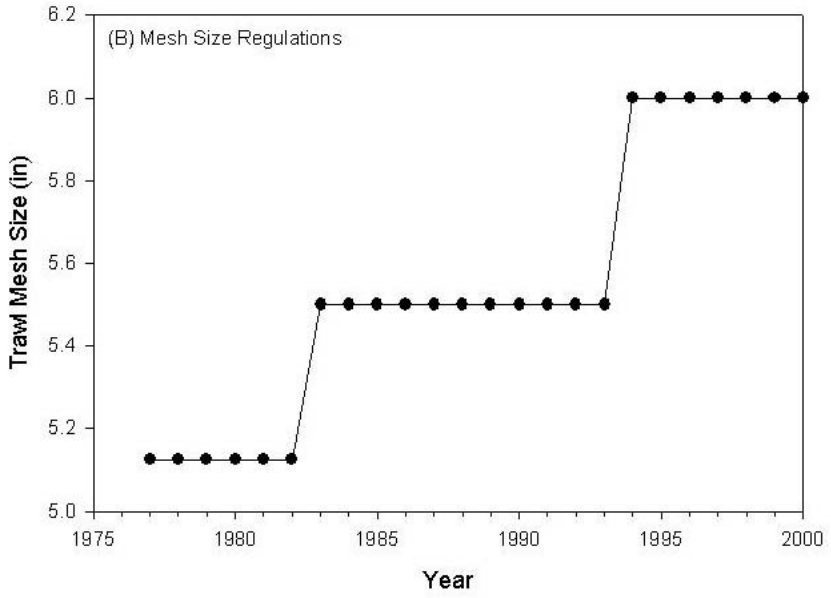


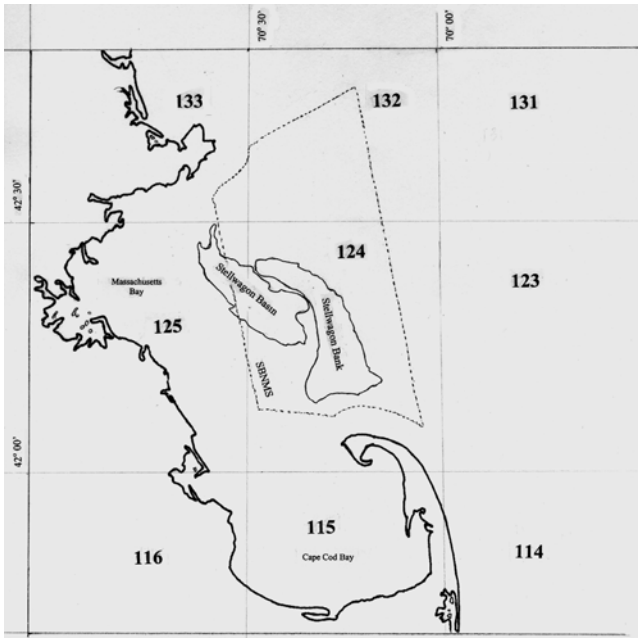
Figure F3. Trends in landings and fishing mortality for Gulf of Maine cod.

  - Management action: Protect essential fish habitat. Conduct FISHER Initiative project to investigate the impacts of storm and tidal events on sand lance habitat and the physical oceanography of Massachusetts Bay.
  - Performance metric: Monitor fraction of Sanctuary's area closed to all mobile fishing gear year-round (e.g., the "sliver" of the Sanctuary that lies within the western Gulf of Maine habitat closed area established in Amendment 13) and monitor monthly fraction of Sanctuary's area subject to rolling closures.

- Management action: Reduce bycatch.
- Performance metrics: Monitor minimum trawl mesh and use at-sea observers to measure bycatch rates and discards of target and non-target species



- **Improve knowledge of Stellwagen Bank's commercial and recreational fisheries**
  - Management actions: Increase fishery observer coverage, catch sampling at ports, and recreational interview coverage. Use existing VTR database to extract all available data on fishing activities by 30 minute blocks. Conduct FISHER Initiative project to chart anecdotal information and oral histories from local fishermen who fish on Stellwagen Bank.
  - Performance measures: Number of observed trips, samples per landed ton, number of interviews. Time series of landings and effort in blocks 124 and 125.



- **Understand Atlantic cod movements**
  - Management action: Complete ongoing cooperative research program to tag Atlantic cod.
  - Performance metrics: Number of commercial and recreational fishermen who return cod tags, number of tags returned.

- **Monitor abundance and distribution of juvenile cod in Sanctuary and adjacent waters**
  - Management action: Initiate cooperative research survey targeting juvenile cod.
  - Performance metrics: Time series of juvenile cod abundance, spatial description of juvenile cod distribution.

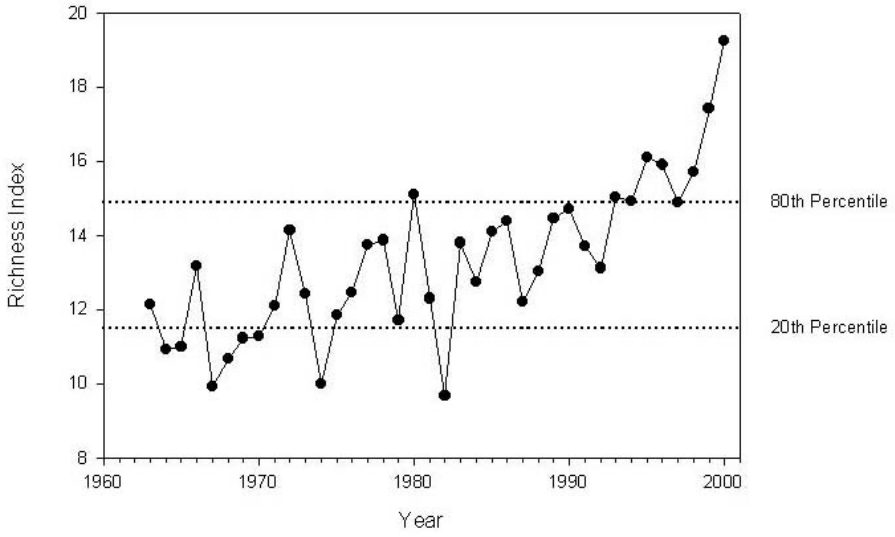
- **Monitor abundance and distribution of sand eels in Sanctuary and adjacent waters**
  - Management action: Initiate cooperative research survey targeting sand eels. Conduct FISHER Initiative project to examine biological processes of sandlance and associated species on Stellwagen Bank.
  - Performance metrics: Time series of sand eel abundance, spatial description of sand eel distribution.

- **Develop comprehensive description of Sanctuary bottom habitat**
  - Management action: Conduct ROV grab sample and video surveys or use other appropriate survey technologies to characterize habitat.
  - Performance measures: Spatial mapping of habitat types at high resolution.

- **Develop appropriate measures of biodiversity within and outside the Sanctuary**

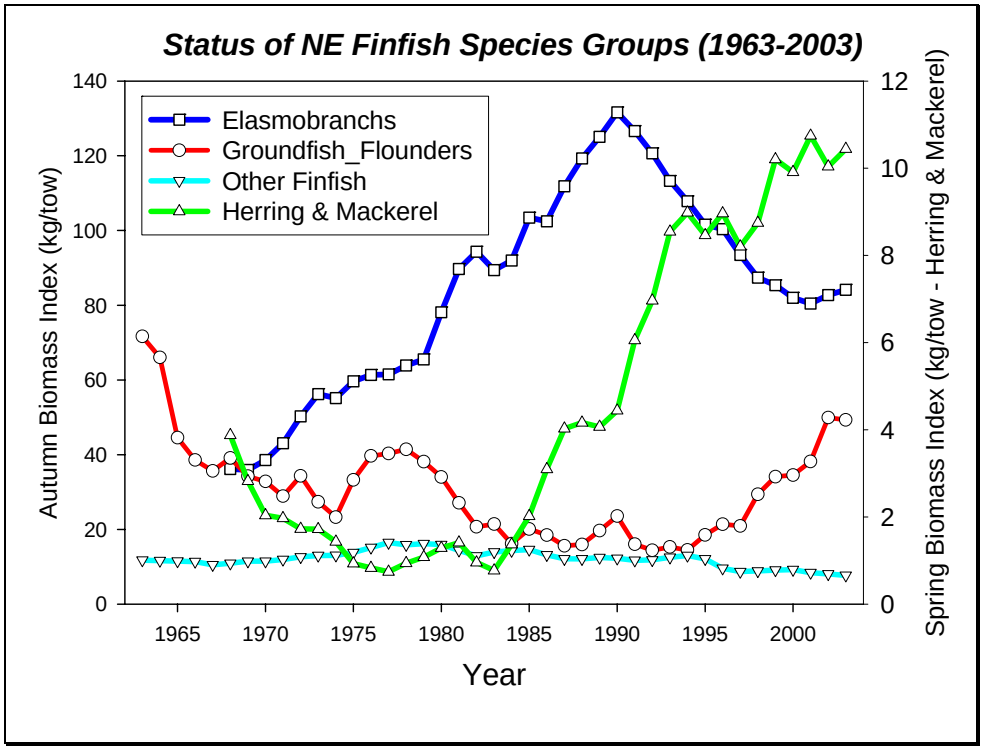
- Management action: Continue long-term research surveys and develop appropriate analyses.
- Performance measures: Time series of biodiversity indices.

Biotic Graph 28. Gulf of Maine Species Richness



- **Improve understanding of the physical and chemical oceanography of the Sanctuary and the Gulf of Maine ecosystem**
    - Management action: Provide funding for development of Gulf of Maine ocean observational systems. Conduct FISHER Initiative project to monitor zooplankton in the Gulf of Maine and on Stellwagen Bank.
    - Performance measures: Continuous online data streams for key physical parameters across the Gulf of Maine.

- **Monitor interrelationships between predators and prey in the Sanctuary and Gulf of Maine ecosystem to understand whether the effects of changes in multispecies abundance have created an imbalance in the food web**
    - Management action: Continue long-term research surveys and develop appropriate analyses.
    - Performance measures: Time series of prey consumption estimates by important predators, such as elasmobranchs, and in particular, information on whether spiny dogfish have impacted the abundance of sand eels and other forage species such as Atlantic herring.



The wealth of the sea belongs to the dead, the living, and those yet to be born.
- coastal proverb

APPENDIX C

DRAFT MIDDLE PATH ACTION PLAN
For consideration by EBMWG at June 3, 2004 meeting

Members: David Pierce, Susan Farady, Ben Cowie-Haskell, Priscilla Brooks

Objectives of plan

- Understand ecosystem structure and function
- Recognize interconnectedness with larger ecosystem
- Recognize our uncertainty of how systems function
- Manage adaptively
- Maintain public accessibility to SBNMS
- Achieve environmental sustainablility of sanctuary resources
- Maintain and enhance biological diversity and ecological integrity
- Reduce habitat impacts by users
- Establish a process for creating a zoning scheme

Strategies

Research Strategies

1. Develop a conceptual ecosystem model showing the functional relationships between species and the transfer of energy through the system.

2. Establish a research steering committee as a working group of the Sanctuary Advisory Council that will assist in developing a research and monitoring plan for the SBNMS, recommending parameters for monitoring that are easily measurable and can serve as biological reference points, and developing an operational and quantifiable definition of ecological integrity. Membership should be comprised of members from SBNMS staff, NEFMC staff, NEFSC staff, academia, fishing industry, and conservation organizations.

3. Establish a collaborative research consortium composed of academic, government, fishermen, and private interests who seek to understand how the sanctuary functions.

4. Evaluate the feasibility and need for expanding the sanctuary boundary to encompass an additional portion of Jeffrey's Ledge.

5. Establish a long-term monitoring program that discerns changes in both the natural and social systems of the sanctuary. This should include direct observations of human uses and cetacean distribution for one year through standardized shipboard sampling conducted every 3-5 years.

6. Establish a directed research program that answers specific questions about how the ecosystem functions including how people effect it and are affected by it. The research consortium should advise on the questions to be answered.

7. Assess the extent of invasive species in the sanctuary and evaluate the threat they pose.

8. Develop predictive larval recruitment, dispersal, and connectivity models that include sources, sinks, larval concentrations, and larval behaviors. This information will be useful in determining the size and location of managed areas.

9. Develop an internal oceanographic circulation model for the sanctuary that will interface with other models and will tie together local, regional, and larger-scale patterns. Development of this model is essential to understand and predict the fate and effect of nutrients, pollutants, and larval transport.

10. Quantify the relative importance of natural and anthropogenic nutrient and other pollutant loadings to sanctuary waters from local, subregional (Mass Bay), and regional (Gulf of Maine) sources.

11. Establish an integrated ocean observing system that collects real-time data at multiple depths on parameters such as:
    a. Temperature (air and water)
    b. Atmospheric pressure
    c. Wave height
    d. Conductivity
    e. Irradiance
    f. Chlorophyll
    g. Current velocity and direction
    h. Ambient noise
    i. Suspended sediments
    j. Dissolved nutrients
    k. Fish abundance
    l. Plankton abundance
    m. Cetacean abundance

    The system could be a subset of the Gulf of Maine Ocean Observing System and would be implemented with a combination of surface buoys and seafloor sensors.

Management Strategies

1. Establish a zoning scheme (including no-take marine reserve(s)) that achieves the following specific purposes:
    - Conserving and enhancing biological diversity
    - Conserving and enhancing genetic diversity
    - Protecting a range of representative habitat types
    - Protecting critical and sensitive habitats (including but not limited to spawning, juvenile, and nursery areas)
    - Improving understanding of SBNMS marine system such as understanding the structure and function of a minimally disturbed habitat and understanding the effects of human exploitation on ecosystem structure and function

    Methodology for establishing zone scheme
    - A recommendation to the SBNMS on a zoning scheme will occur within two years of implementation of final management plan.
    - Establish a zoning working group composed of stakeholders (users and non-users) to establish a zoning scheme based on the information below. Alternative: the EBMWG

continues to meet over the next two years dealing with the issue of developing a zoning scheme(s)

- The group will evaluate and consider the following types of information:
  - geological and sediment information
  - identification of different habitat types, including particularly unique or sensitive habitats
  - information on habitats/areas that are frequented by animals that are of particular concern to the Sanctuary, for example marine mammals, other endangered species such as sea turtles, species of concern such as seabirds, selected fish species
  - information on the location, composition, and sensitivity of ecological communities, (ex. boulder reef communities, mud bottom communities, etc.)
  - location of human activities using or impacting Sanctuary resources (ex. vessel traffic lane, whale watching activity, fishing activities, etc.)
  - limitations imposed by other regulatory schemes within the Sanctuary (ex. location of existing federal and state fishing management zones, location of existing marine mammal protected areas, etc.)
  - assessments using a-f above and other information as needed to identify areas of particular concern where Sanctuary resources need increased protection to accomplish the EBM goal and meet the Sanctuary Act's requirements.

2. Require vessel monitoring systems (VMS) for all recreational for-hire and commercial fishing vessels in the sanctuary.

3. Require automated identification systems (AIS) for all vessels not involved in commercial fishing or recreational for-hire fishing.

4. Request that the NEFMC implement a 10-year moratorium on trawling and seining for Atlantic herring (*Clupea harengus*) in the SBNMS in order to discern the effects of the herring fishery on sanctuary resources.

5. Request that the NEFMC implement a permanent ban on the exploitation of sand eels (*Ammodytes* spp.) in SBNMS.

6. Increase observer coverage on fishing vessels using the SBNMS.